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FR-69-8

FINAL REPORT

# CONTROLLED RANGE NETWORK

SPECIAL ACCESS REQUIRED

REC'D IN PFR-1
17 NOV 1969

COORDINATION

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FINAL REPORT

# CONTROLLED RANGE NETWORK

by

[redacted] 25X1

[redacted] 25X1

November 1969

SPECIAL ACCESS REQUIRED

GROUP 3
DOWNGRADED AT 12 YEAR INTERVALS;
NOT AUTOMATICALLY DECLASSIFIED

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Prepared For

Directorate of Reconnaissance Engineering
Deputy For Engineering
Aeronautical Systems Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

[redacted] 25X1

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## FOREWORD

This report covers work performed by [redacted] in compliance with the requirements of Contract [redacted] as specified in its accompanying statement of work.

The work was conducted between 1 October 1968 and 30 September 1969. Mr. [redacted], served as the Program Manager for the United States Air Force, Directorate of Systems Engineering (ASNQD-50) Wright-Patterson Air Force Base, Ohio, and [redacted] was his alternate.

A number of the technical staff of [redacted] provided services in this project. Principal personnel engaged in this project included [redacted] and the author.

The manuscript of this report was submitted by the author for initial review on 30 September 1969. It is identified by the contractor's file number FR-69-8.

This technical report has been reviewed and is approved.

[redacted]

Project Manager
Directorate of Reconnaissance Engineering

UNCLASSIFIED ABSTRACT

This report summarizes activity relating to the Controlled Range Network during the period of 1 October 1968 to 30 September 1969. This final report presents a resume of services provided for the United States Air Force by [redacted] in response to the requirements of Contract [redacted]

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The procedures used to provide targeting service, preparation of related publications, scope of collateral services, and certain related research efforts are described.

CONTENTS

## SECTION I

## INTRODUCTION

Confirmation of the dynamic capability of modern aerial reconnaissance systems is essential in the development and operational use of these systems. Continuing dynamic evaluation must be an integral process to insure that the basic system delivers the quality it was designed to produce and that such quality is maintained throughout its operational life. The ability to measure quantitative performance of a total reconnaissance system is a prerequisite to further progress. Indeed, further significant development and refinement in the intelligence system gathering capabilities will occur at a rate proportional to the capability to evaluate systems as they are developed and employed.

A number of ground evaluation standards together with their related analysis techniques have been designed for the purpose of providing a basic capability to support the development and evaluation of photographic, [redacted] reconnaissance systems. 25X1

This array of ground targets and associated instrumentation capability, together with the experienced technical personnel to operate it effectively, comprise the Controlled Range Network.

The resources of the Controlled Range Network are available on a nationwide basis to members of the reconnaissance community. Any customer, through a simplified communication channel, can be provided with an array of evaluation standards, meaningful photometric and atmospheric instrumentation data from which to analyze the overall performance of a system.

This final report presents a summary of activity related to the Controlled Range Network provided for the United States Air Force by [redacted] 25X1

## SECTION II

## TECHNICAL DISCUSSION

### A. GENERAL

The Controlled Range Network is operated by [redacted] from its principal facility at [redacted] Personnel in the [redacted] office manage all aspects of the operation of the range network, and provide a variety of supporting services.

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The principal area of endeavor is targeting service. This is provided by one crew based in [redacted] and by eight other field crews located across the nation.

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Supporting services include certain research efforts, material procurement for special projects, an overall quality control program, maintenance of a multisensor test capability and publication of handbooks.

### B. FIELD OPERATIONS

Targeting service in the field is provided by nine target crews. Each crew is provided with a specified group of targets and supporting instrumentation so that, when required, a series of nine similar target groupings can be displayed. Instrumentation can also be provided at fixed target sites concurrently, as required.

The target set and crew are transported from the operating base to the display site by a heavy-duty truck, especially configured to accommodate both crew and targets. Communications from [redacted] to each operating base are by Teletype.

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The nine operating bases are located at cities as shown in Figure 1. When a target display is required, the crew nearest the requested site is directed to display the targets.

During the past year, two field crews have been relocated to provide better geographic coverage. The El Paso unit was moved to Albuquerque to increase the operating radius, and the target unit formerly at Kansas City was relocated in Springfield, Missouri, because Kansas City performance was unsatisfactory.

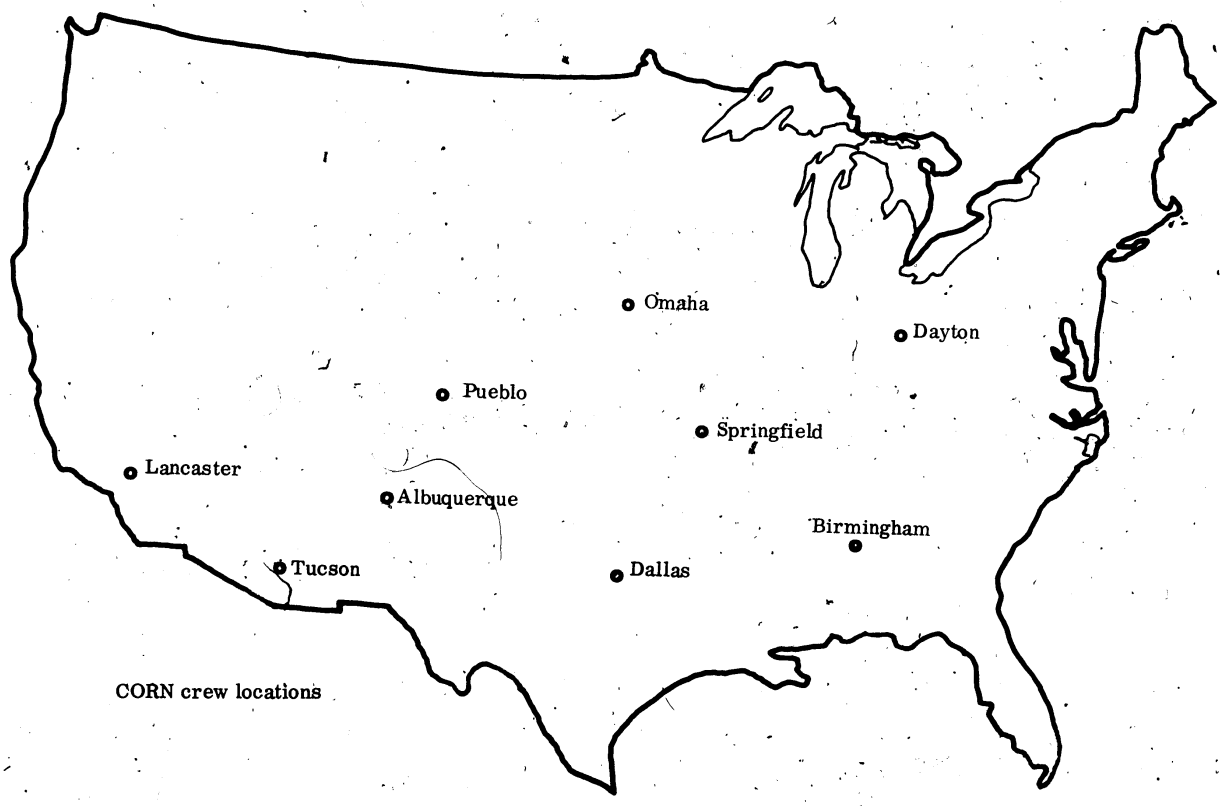


Figure 1. Target Operating Bases

Historically, the pattern of requested display locations changes and future distribution may not be entirely predictable. Operating experience indicates that these locations are satisfactory, considering both the geographical distribution and the sequence of displays in given CORN operations. The expense incurred in the selection and training of new CORN target crews as well as a reduction in initial proficiency during the transition period is significant. Thus, in the interest of overall economy, relocation of the field crew is done only for most compelling reasons.

Such a magnitude of field operations requires a proportional amount of supporting services by the [redacted]

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To assure that the basic set of data is most meaningful, the targets and associated instrumentation employed in the field must be maintained at a uniform level of quality. Spectral characteristics of representative samples of each reflectance area of each target are measured bi-monthly. Samples are measured on a single-beam recording spectrophotometer at [redacted]

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Each 70 mm Hasselblad camera is recalled from the field and recalibrated at intervals of 180 days. This calibration process is accomplished by [redacted] technicians using both in-plant test equipment and certain specialized items of calibration equipment in the Avionics Laboratory at Wright-Patterson Air Force Base.

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Energy measurement equipment such as radiometers, light meters, and brightness meters are calibrated at intervals of 45 to 90 days.

If any instrumentation component malfunctions in the field, it is immediately recalled to [redacted] for repair and recalibration, and it is replaced with a similar unit which has been recently certified.

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In addition to these mechanical functions, there are other aspects of the operation in which quality is constantly monitored. Great emphasis is placed on quality of target displays and operations in the field and related operational procedures in field exercises.

Technicians from [redacted] who are thoroughly experienced in every aspect of the field operation, make unannounced inspections at a number of target

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display sites during field operations. This helps to assure that the targets are displayed correctly and that the procedures for data collection used by the field crews are correct.

Since this practice was implemented at the beginning of this year, display quality has improved markedly. This is evidenced by the on-site quality control report as well as by a significant reduction in the number of previously unreported discrepancies on feedback reports.

C. COLLATERAL SERVICES

1. Handbooks: A continuing survey is conducted of test ranges, fixed targets and other test facilities available for reconnaissance system testing throughout the nation. Results of this survey are compiled and published in the Controlled Range Network manual. Distribution of this manual is controlled.

The CORN manual was completely revised both in format and content in June 1968. During the past year, three major revisions have been published and distributed.

A second major publication, although more limited in distribution, is the Handbook of Standard Operating Procedures. This prescribes operation of the Controlled Range Network in each of its facets. This manual has been completely rewritten and revised in format to reflect the cumulative changes in operational procedures which have occurred since it was last revised.

2. Reports: Monthly reports are prepared and submitted in accordance with the contract requirements specified in the DD Form 1423. These summarize operational and support activity which has occurred in the previous thirty days and itemize fund expenditures on the contract in the major cost categories.

3. Special Research: A major endeavor associated with this contract, but funded separately, is a research function. Work done in this area is reported separately.

However, the search for better target base materials and improved coatings and application techniques has been continued within the scope of the contract.

Two light-weight edge analysis targets were fabricated during the 1968 CORN target replacement cycle. The base material was 2.4-ounce nylon which was coated with a polyurethane reflective emulsion. The result is an extremely light-weight target of greater durability than canvas. The reflective emulsion has a more uniform spectral response across the visible spectrum than the coatings used previously.

The lighter material permitted a change in design which, in turn, reduced the time required for deployment. There are minor problems encountered in recovering the target during windy conditions, but the overall operational advantages are significant.

Prototype disposable photographic standard targets were developed as a part of a supplementary task under this contract. These targets were fabricated from a durable, light-weight paper and consist of a twenty-six bar group photographic resolution target and a five-step gray scale. The targets are identified as the Type LS-88(XA-1) Photo Systems Analysis Target Kit and provide operational reconnaissance squadrons with an economical means to evaluate dynamically their photographic systems in the operational environment.

The target kit has been evaluated by the Tactical Air Reconnaissance Center, Shaw Air Force Base, South Carolina, and has been employed operationally by a number of other organizations. It was found suitable for low-altitude use and further development of both photographic and infrared analysis targets is expected.

4. Mobile Multisensor Target Array: A mobile capability with expanded facilities for the operational test and evaluation of reconnaissance systems is maintained in a standby status. This collective capability is identified as mobile multisensor units and they are comprised of specially designed targets and supporting instrumentation. Facilities are provided for the test of infrared ground mapping systems and radar reconnaissance systems, as well as photographic and electro-optical systems.

Two of these multisensor units are available for extended use within the structure of the requester's test program.

During this reporting period, utilization of the multisensor units was severely curtailed by lack of funds to support their operation. While requests for multisensor support remained at the same high level as in previous years, only three requesters were able to provide funds for short-term operations.

Although these mobile multisensor units are being kept in serviceable condition, they are equipped with the original canvas targets.

5. Material Procurement: When it is expeditious from an operational standpoint, certain material is purchased directly for use on the overall CORN Program. During the past year, a number of ground targets of unique design, as well as special equipment items, were procured in this manner. A number of replacement targets were procured as an additional contract task. New targets procured in this period included four 51-51 T-Bar resolution targets, four MIL-STD-150A resolution targets, four medium-contrast T resolution targets, and five edge analysis targets (two of which were fabricated of light-weight nylon base material.)

6. Special Test Support: At the direction of the Air Force, 182 man-days of targeting and instrumentation support were provided for a series of off-shore tests. Unique problems were encountered, such as medically sterilizing two 16,650 sq. ft. canvas targets, and accounted for a significant portion of this time.

## SECTION III

## OPERATIONS ANALYSIS

The total number of field exercises and target displays during this period has been significantly less than those during previous twelve-month periods. An analysis of total target displays requested is shown in Figure 2.

Of the total requested, 71.9% were completed, 14.4% were not made due to inclement weather, and 8.5% were cancelled by the requester. The balance were not completed for miscellaneous causes.

Time available to deploy the standard target set is directly relatable to the quality of the display. Average display time required for the standard configuration is 3-1/2 hours. Distance to the display site and starting time of the operating period are factors which determine the time available to make the display. Time required to locate and obtain permission to use a suitable site within the display zone generally requires an additional 1-1/2 hours. Considering this elapsed time, operating periods which begin at 0700 or 0800 hours severely limit the time the crew can spend in target deployment and has an effect on display quality. Realizing certain operational requirements, some quality decay in the last two months of this reporting period is attributed to this set of circumstances. An analysis of operation starting times is shown in Figure 3.

The effect of improved communications between the requesting agency and the contractor's operating group cannot be too strongly emphasized. The free flow of essential information has played a significant part in the overall improvement which has taken place during this past year.

As an example, the rise in percentage of completed displays is a direct result of improved communication. Prior to February, a number of requested display sites were centered on metropolitan areas and were thus impossible to complete. When this problem was discussed, it was determined that commercial airports with large, flat, open areas in the same alignment pattern could be utilized without penalty, and permitted displays of improved quality. Similarly, size of the display zone was

| Total CORN Target Displays Requested 1 Oct. 1968 30 Sept. 1969 | | Total Displays Requested | Cancelled Displays | CANCELLATION CAUSES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Rain | Snow | Wind | Truck Breakdown | No Site Available | By Requester | Wrong Coordinates | |
| October | | 0 | | | | | | | | | |
| Nov. | C | 31 | 9 | 4 | | 1 | 1 | 3 | | | |
| | B | 27 | 3 | 1 | | 1 | 1 | | | | |
| Dec. | C | 10 | 1 | | | | | 1 | | | |
| | Special | 8 | | | | | | | | | |
| Jan. | C | 41 | 23 | 10 | 6 | 1 | | | 6 | | |
| | Special | 2 | | | | | | | | | |
| Feb. | B | 12 | 3 | 2 | | | | | 1 | | |
| | Special | 7 | 1 | 1 | | | | | | | |
| March | C | 20 | 3 | 1 | 1 | | | | 1 | | |
| | Special | 2 | 1 | | | 1 | | | | | |
| April | C | 26 | 6 | 2 | | 3 | 1 | | | | |
| May | Special | 7 | 2 | | | | | | 2 | | |
| June | C | 15 | 4 | 2 | | 1 | 1 | | | | |
| | Special | 3 | 1 | | | | | | | | |
| July | B | 12 | 4 | | | | | | 1 | | |
| | Special | 1 | | | | | | | 4 | | |
| August | B | 10 | 6 | | | | 1 | | 5 | | |
| | C | 24 | 8 | | | | 1 | 2 | 4 | 1 | |
| | Special | 4 | | | | | | | | | |
| Sept. | C | 9 | 1 | | | 1 | | | | | |
| TOTAL | | 261 | 76 | 23 | 7 | 9 | 6 | 6 | 24 | 1 | |

Figure 2. Analysis of Target Displays

| DISPLAY TIME | | | | | 1 October 1968 - 30 September 1969<br>Total Displays with Crews in the Field | | |
|---|---|---|---|---|---|---|---|
| | 0600-0700 | 0700-0800 | 0800-0900 | 0900-1000 | 1000-later | Total | |
| October | | | | | | 0 | |
| November | | | | 2 | 16 | 18 | |
| December | | | | | 31 | 31 | |
| January | | | | | 43 | 43 | |
| February | | | | | 19 | 19 | |
| March | | | | | 22 | 22 | |
| April | | | 2 | 18 | 6 | 26 | |
| May | | | 2 | 5 | | 7 | |
| June | | 2 | 11 | 3 | 2 | 18 | |
| July | 5 | | | | 8 | 13 | |
| August | | 13 | 12 | | 13 | 38 | |
| September | | | 5 | 4 | | 9 | |
| TOTAL | 5 | 15 | 32 | 32 | 160 | 244 | |

**Figure 3. Display Time Analysis**

extended to provide a larger selection of display sites within the zone. Each of these relatively minor matters led to better displays and a greater amount of data "take".

The effectiveness of Hasselblad edge target photography is another direct result of better information flow. Only in the last half of this reporting period have the data extracted from this photography been correlatable with other basic data. Again, this is directly attributable to a continuing open discussion of the problems involved and a methodical, deliberate attempt to solve them.

At the beginning of this reporting period, there was an absence of timely critique regarding the CORN target displays. It is noted, however, that during the last four months of this period there have not been sufficient critical comments to warrant a formal critique.

## SECTION IV

## CONCLUSIONS

1. There has been an improvement in the quality of field operations as well as a marked improvement in the quality of Hasselblad edge target photography. Both of these improvements are direct results of improved information flow and discussion of operating problems between the requesting agency and the contractor's operating group.

2. The display quality and the useful life of CORN targets can be enhanced if targets are fabricated from light-weight synthetic materials.

3. Development and evaluation of the type LS-88(XA-1) Photo Systems Analysis Target Kit during this period were highly successful. When this type of target kit becomes more readily available, it will provide a uniform evaluation capability which can be employed by operational reconnaissance units on a worldwide basis.

## SECTION V

## RECOMMENDATIONS

1. CORN targets which have large, single reflectance areas, such as edge analysis targets and gray scales, should be made of lighter weight nylon material. This will extend their useful life, reduce the display time, improve quality of the display, and will probably increase both the quality and quantity of raw data. A small number of resolution targets should be fabricated from this type of material to ascertain its suitability for this type of target.

2. Every effort should be made to further improve the process of communication from the requester to the contractor's operating group. While it is recognized that there are certain necessary constraints, the communications function should be developed so that there is a greater understanding of problems associated with each part of the overall operation.

The dynamic system analysis capability provided by the type of evaluation standards such as those in the type LS-88(XA-1) Photo Systems Analysis Target Kit, as well as the technology evolved in this development, should be fully exploited with minimum possible delay to provide this capability to operational reconnaissance units. Proper use of these types of standards will provide a capability which is not now generally available to these units, will permit a more objective evaluation of raw data, and will permit more positive identification of system malfunctions and causes of image degradation. When the sources of degradation are removed, the quality of both the image and the intelligence information extracted from it will improve.